

What is claimed is:

1. A method of detecting a magnetic particle, said method comprising:
placing a first magnetic particle at a first location in a fluid medium;
applying a magnetic flux through a portion of the medium including the first location;
and
observing movement of the magnetic particle in the fluid medium from the first location to a second location.
2. The method of claim 1 wherein the magnetic particle comprises a Fe/Au nanoparticle having at least one binding agent attached thereto.
3. The method of any of claims 1-2 wherein the magnetic particle comprises a Au nanoparticle different from the Fe/Au nanoparticle.
4. The method of claim 3 wherein the Au nanoparticle is attached to the at least one binding agent.
5. The method of claim 3 wherein the Fe/Au nanoparticle comprises a first binding agent and the Au nanoparticle comprises a second binding agent different from the first binding agent.
6. The method of claim 5 wherein the first binding agent comprises a first single stranded DNA fragment and the second binding agent comprises a second single stranded DNA fragment capable of hybridizing to at least a portion of the first DNA fragment.
7. The method of claim 5 wherein the first binding agent binds to the second binding agent.
8. The method of claim 7 wherein the target material displaces the second binding agent from the first binding agent.

9. The method of claim 2 wherein the magnetic particle comprises a bound magnetic transducer having a target material attached to the at least one binding agent.
10. The method of claim 9 wherein a Au nanoparticle is attached to the at least one binding agent.
11. The method of claim 9 wherein the bound magnetic transducer comprises a Au nanoparticle having at least one second binding agent different from the at least one first binding agent.
12. The method of claim 9 wherein the at least one binding agent comprises a first single stranded DNA fragment and the at least one second binding agent comprises a second single stranded DNA fragment capable of hybridizing to at least a portion of the first DNA fragment.
13. The method of any of claims 9-12 wherein the target material comprises a DNA fragment or an antigen.
14. The method of any of claims 9-13 wherein the target material is selected from group consisting of: proteins, peptides, carbohydrates polysaccharides, glycoproteins, lipids, hormones, receptors, antigens, allergens, antibodies, substrates, metabolites, cofactors, inhibitors, drugs, pharmaceuticals, nutrients, toxins, poisons, explosives, pesticides, chemical warfare agents, biohazardous agents, vitamins, heterocyclic aromatic compounds, carcinogens, mutagens, narcotics, amphetamines, barbiturates, hallucinogens, waste products.
15. The method of claim 9 wherein the bound magnetic transducer comprises both a Fe/Au nanoparticle and a Au nanoparticle.
16. The method of any claim 9-15 wherein the bound magnetic transducer comprises a plurality of Fe/Au nanoparticles and a plurality of Au nanoparticles.
17. The method of any of any of claims 1-16 wherein the medium is an aqueous medium.

18. The method of any of claims 1-17 wherein the medium comprises agarose.
19. The method of any of claims 1-18 wherein said observing comprises optically detecting the magnetic particle.
20. The method of any of claims 1-19 wherein said optically detecting comprises detecting electron scattering density using transmission electron microscopy techniques.
21. The method of any of claims 1-20 wherein said optically detecting comprises detecting a fluorescent, radioactive, chemiluminescent, electrochemiluminescent, or enzymatically labeled agent.
22. The method of any of claims 1-21 comprising a second magnetic particle adjacent to the first magnetic particle.
23. The method of claim 22 wherein said second magnetic particle moves at a velocity different than said first magnetic particle.
24. The method of any of claims 22-23 wherein said second magnetic particle has a different hydrodynamic volume or magnetic susceptibility different from the first magnetic particle.
25. The method of any of claims 22-24 wherein the second magnetic particle comprises a binding agent bound to a second target material.
26. The method of any of claims 22-25 wherein the second target material comprises a single stranded DNA fragment or an antigen.
27. The method of any of claims 22-25 wherein the second target material is selected from group consisting of: proteins, peptides, carbohydrates polysaccharides, glycoproteins, lipids, hormones, receptors, antigens, allergens, antibodies, substrates, metabolites, cofactors, inhibitors, drugs, pharmaceuticals, nutrients, toxins, poisons,

explosives, pesticides, chemical warfare agents, biohazardous agents, vitamins, heterocyclic aromatic compounds, carcinogens, mutagens, narcotics, amphetamines, barbiturates, hallucinogens, and waste products.

28. The method of any of claims 1-6 comprising adding the magnetic particle to a sample suspected of containing a target material of interest.
29. The method of claim 28 comprising using a magnetic source to partition any magnetic material in the sample.
30. The method of claim 28 comprising collecting any magnetic material from the sample.
31. A method of analyzing a sample suspected of comprises a target material of interest, said method comprising:
 - preparing a magnetic transducer comprising a Fe/Au nanoparticle functionalized with a first binding agent wherein the Fe/Au nanoparticle exhibits a first magnet moment;
 - adding the magnetic transducer to the sample in an amount sufficient to bind to a target material in the sample and yield a bound transducer complex having the target material bonded thereto; and
 - determining the magnetic moment exhibited by the Fe/Au nanoparticle of the bound transducer complex.
32. The method of claim 31 wherein the magnetic transducer comprises a plurality of Fe/Au nanoparticles.
33. The method of claim 31, wherein the first binding agent is bound to a first Fe/Au and to a second Fe/Au particle.
34. The method of any of claims 31-33 wherein the binding agent in the transducer is flexible in the sample.

35. The method of any of claims 31-34 wherein the binding agent in the bound transducer complex is constrained.

36. The method of any of claim 31-35 wherein the binding agent comprises a single stranded DNA fragment.

37. The method of any of claim 31-36 wherein the target material comprises a single stranded DNA fragment.

38. The method of any of claims 31-37 comprising comparing the magnetic moment of the magnetic transducer to the magnetic moment of the bound transducer complex.

39. The method of any of claim 31-38 wherein said determining the magnetic moment comprises observing the mobility of the bound transducer complex in a magnetic field.

40. A method of analyzing a sample for a target material, said method comprising:
preparing a magnetic transducer comprising a magnetic susceptible nanoparticle having at least one binding agent attached thereto said binding agent selected to bind to the target material in the sample;
providing a labeled binding partner capable of binding to the binding agent; and
adding the magnetic transducer and the labeled binding partner to the sample.

41. The method of claim 40 wherein the binding partner is bound to the magnetic transducer to provide a first bound transducer complex prior to being added to the sample.

42. The method of claim 40 wherein the magnetic transducer and the labeled binding partner are added to the sample separately.

43. The method of any of claims 40-42 wherein the binding partner comprises a Au nanoparticle having at least one organic group bonded thereto.

44. The method of any of claims 40-43 wherein the target material displaces the binding partner from the first bound transducer complex to yield a second transducer complex.
45. The method of any of claims 40-44 wherein the target material is an antibody or an antigen.
46. The method of any of claims 40-44 wherein the binding partner is an antibody or an antigen.
47. The method of any of claims 40-44 wherein the binding group is an antibody or an antigen.
48. The method of claim any of claims 40-44 wherein the target material is selected from the group consisting of: proteins, peptides, carbohydrates polysaccharides, glycoproteins, lipids, hormones, receptors, antigens, allergens, antibodies, substrates, metabolites, cofactors, inhibitors, drugs, pharmaceuticals, nutrients, toxins, poisons, explosives, pesticides, chemical warfare agents, biohazardous agents, vitamins, heterocyclic aromatic compounds, carcinogens, mutagens, narcotics, amphetamines, barbiturates, hallucinogens, and waste products.
49. A device for analyzing a sample suspected of containing a target material, said device comprising:
- a container configured to retain at least a portion of the sample, said container comprising at least one wall;
 - a magnet disposed adjacent to the at least one wall; and
 - an optical detector positioned next to the container and configured to detect the present of one or more species in the sample.
50. The device of claim 49 wherein the detector is positioned next to the at least one wall and adjacent to the magnet.
51. The device of claim 49 wherein the detector is spaced from the magnet.

52. The device of any of claim 49-51 wherein the optical detector using transmission electron microscopic techniques to analyze for the presence of one or more species in the sample.